Perspective

N-Theory: From LHC to Webb

Hosein Nasrolahpour*

School of Computational Science and Engineering, University of Tehran, Tehran, Iran.

Abstract

In the N-theory we consider phenomena occurring in nature fundamentally nonlocal which result in such an interconnected universe that we have. In this theory we investigate systems and phenomena in the framework of fractional dynamics and using the tool of fractional calculus which intrinsically incorporate spacetime nonlocalities in theoretical formulation. Spacetime nonlocality which in particular in time domain is called memory effect is a fundamental characteristic such that we can predict to find some experimental evidences for it at both quark, astronomical and cosmic scale in future results coming from the LHC and James Webb Space Telescope (JWST). In this work we give some new insights.

Keywords: Fractional dynamics, memory effect, nonlocality, LHC, James Webb, Space Telescope.

1. Introduction

N-theory deals with the space-time nonlocality in nature [1]. In this theory all fundamental interactions are considered intrinsically nonlocal which result in an interconnected universe at all scales. Nowadays we know that space nonlocality and memory effect (time nonlocality) will result in complexity in many different phenomena in nature. The best tool for investigation of nonlocal phenomena is the tool of fractional calculus which intrinsically incorporate spacetime nonlocalities in theoretical formulation of the problem. So, when we want to study a structure which exhibits a complex dynamic at its fundamental level we should work in the framework of fractional dynamics. In this framework we have fractional generalized form of well-known areas of physics including: classical mechanics, fluid dynamics, electromagnetic, quantum mechanics, special and general relativity and field theory.

For this purpose, we use the well-known Caputo partial fractional derivatives for the time derivatives and the Riesz fractional derivatives for the space ones and defining the fractional Laplacian. Left (forward) and right (backward) Caputo (RL) partial fractional derivatives of order α_μ , β_μ (which are positive real or even complex numbers) of a real valued function f of $d+1$ real variables $x^0, x^1, ..., x^d$ with respect to x_μ are as follow:

$$ {}_{a_\mu}^{C}\partial_\mu^{\alpha_\mu} f(x^0,...,x^d) = \frac{1}{\Gamma(n_\mu - \alpha_\mu)} \int_{a_\mu}^{x} \frac{\partial_{x^\mu}^{n_\mu} f(x^0,...,x^{\mu-1},u,x^{\mu+1},...,x^d)}{(x^\mu - u)^{1+\alpha_\mu - n_\mu}} du \quad \text{(left Caputo)} \qquad (1) $$

*Correspondence: Hosein Nasrolahpour, University of Tehran, Tehran, Iran. E-Mail: hnasrolahpour@gmail.com & hnasrolahpour@ut.ac.ir

$$ {}_{\mu}^{C}\partial_{b_\mu}^{\beta_\mu} f(x^0,...,x^d) = \frac{(-1)^{n_\mu}}{\Gamma(n_\mu - \beta_\mu)} \int_x^{b_\mu} \frac{\partial_{x^\mu}^{n_\mu} f(x^0,...,x^{\mu-1},u,x^{\mu+1},...,x^d)}{(u-x^\mu)^{1+\beta_\mu - n_\mu}} du \quad \text{(right Caputo)} \qquad (2) $$

where $\partial_{x^\mu}^{n_\mu}$ is the ordinary partial derivative of integer order n with respect to the variable x and a_μ , b_μ are real number which define the domain [1 and refs. therein]. Also, for the Riesz fractional derivative of order α_μ we have:

$$ {}^{R}\partial^{\alpha_\mu} f(x^0,...,x^d) = \frac{1}{2\cos(\pi\alpha_\mu/2)\Gamma(n_\mu - \alpha_\mu)} \partial_{x^\mu}^{n_\mu} \left(\int_{-\infty}^{x^\mu} \frac{f(x^0,...,x^{\mu-1},u,x^{\mu+1},...,x^d)}{(x^\mu - u)^{1+\alpha_\mu - n_\mu}} du + \int_{x^\mu}^{\infty} \frac{f(x^0,...,x^{\mu-1},u,x^{\mu+1},...,x^d)}{(u-x^\mu)^{1+\alpha_\mu - n_\mu}} du \right) \qquad (3) $$

Using the above fractional operators, we will have the following table for the main formulas in each area:

Classical mechanics	Newton's Second Law of Motion	$F = ma = m\eta_\alpha \dfrac{d^\alpha x}{dt^\alpha}$ (4)
Fluid dynamics	Navier–Stokes equation	$\eta_\alpha \dfrac{\partial^\alpha u}{\partial t^\alpha} + \sigma_\alpha \left(u.\nabla^\alpha\right)u - \sigma_\beta \nu \nabla^\beta u = -\dfrac{\sigma_\alpha}{\rho}\nabla^\alpha p$. (5)
Electromagnetics	Maxwell's equations	$\sigma_\alpha \vec{\nabla}^\alpha . \vec{E} = \dfrac{4\pi}{\varepsilon}\rho(\vec{r},t)$ (6) $\sigma_\alpha \vec{\nabla}^\alpha . \vec{B} = 0$ (7) $\sigma_\alpha \vec{\nabla}^\alpha \times \vec{E} = -\dfrac{\eta_\alpha}{c}\dfrac{\partial^\alpha \vec{B}}{\partial t^\alpha}$ (8) $\sigma_\alpha \vec{\nabla}^\alpha \times \vec{B} = \dfrac{4\pi\mu}{c}\vec{j}(\vec{r},t) + \dfrac{\eta_\alpha \varepsilon\mu}{c}\dfrac{\partial^\alpha \vec{E}}{\partial t^\alpha}$ (9)
Quantum mechanics	Schrödinger equation	$-\dfrac{\hbar^2 \sigma_\beta}{2m}\nabla^\beta \Psi + V(x)\Psi = i\hbar\eta_\alpha \dfrac{\partial^\alpha \Psi}{\partial t^\alpha}$ (10)
Relativity	Einstein field equations Christoffel symbol	$\left(R^\alpha\right)_{\mu\nu} - \dfrac{1}{2} g_{\mu\nu} R^\alpha = \dfrac{8\pi G}{c^4}\left(T^\alpha\right)_{\mu\nu}$ (11) (12) $\left(\Gamma^\alpha\right)_{\nu\lambda}^{\mu} = \dfrac{1}{2} g^{\mu\rho}\left(\left(\partial^\alpha\right)_\nu g_{\rho\lambda} + \left(\partial^\alpha\right)_\lambda g_{\rho\nu} + \left(\partial^\alpha\right)_\rho g_{\nu\lambda}\right)$

Table 1. Physics in the framework of fractional dynamics

2. From LHC to Webb

In our previous work [1], we investigated LHC new results in the framework of fractional dynamics and found that the calculated masses of exotic baryons through this framework are completely close to the observed and experimentally calculated masses with an error less than 1%. Based on the approach discussed in [1] we can easily calculate mass spectra for many other possible exotics particles which certainly will report by LHC in near future. With this success which shows that how mush this approach is powerful we predict that the situation will be the same for the future data coming from modern telescopes such as the JWST.

Recently, a fractional generalization of blackbody radiation law and its application to NASA COBE data presented [2]. In this work, they obtained a formula for the Planck blackbody radiation law as:

$$U_F(T,\nu,\alpha)=\frac{8\pi h\nu^3}{c^3}\left[\frac{1}{e^x-1}+\frac{\alpha-1}{(e^x-1)^2}\sum_{k=0}^{\infty}\frac{kx^k[\psi(k+1)-\ln x]}{\Gamma(k+1)}\right] \tag{13}$$

where $x=\dfrac{h\nu}{k_BT}$ and $\psi(z)=\dfrac{d(\ln\Gamma(z))}{dz}$ is the digamma function. By analyzing NASA COBE data, they found that there is a strong correlation between chemical potential and fractional order of the model.

These days JWST has started its mission in space. JWST is a space telescope working based on the infrared astronomy. Having access to low-temperature blackbodies is the key point of infrared astronomy. So, we expect to receive new data from JWST telling us about the role of fractional dynamics at the astronomical and cosmological scales.

3. Conclusion

Nowadays, it is well-known that the fractional order of a dynamical system is closely related to the physics of systems and can be considered as an index of fractality, different kind of memory effect (gravitational, electromagnetic, shape etc. [3]) and space nonlocality. We expect new data from LHC and JWST tell us more about these effects in near future.

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